Acoustic behaviour of small cetaceans in northwest Peninsular Malaysia in relation to behavioural, environmental and anthropogenic factors

(マレーシア半島北西部における小型鯨類の発声と行動、環境及び人為的要因の関係)

Saliza binti Awang Bono

Abstract

Small odontocetes rely on sounds for foraging, navigation, and communication. In Malaysia, there is a knowledge gap on dolphin acoustics and there is a need to investigate the influence and impacts posed to the animals with regard to noise and their natural surroundings. This study, conducted in the Langkawi Archipelago and adjacent mainland Perlis-Kedah coastal waters in northwestern Peninsular Malaysia, aims to examine the dolphins' acoustic behaviour in relation to behavioural and environmental factors, and boat noise impacts which are likely to affect the dolphins' acoustic variation. In these study sites, two commonly found coastal species that emit whistles; the Indo-Pacific humpback dolphin (*Sousa chinensis*) (hereafter humpback dolphins) and Irrawaddy dolphin (*Orcaella brevirostris*), are the focus of this study. As for an offshore species in the study area, the spinner dolphins (*Stenella longirostris*) were recorded and included in the thesis. Four boat-based surveys were conducted from 2019 to 2021, covering a total area of 3848.6 km. The vocalization parameters calculated were the vocalization rate, duration, whistle mean frequency, whistle coefficient of frequency modulation (COFM) and inter-click intervals (ICI). The sound characteristics of each species were clarified in detail in Chapter 2. A total of 4971, 17 and 46 whistles were successfully recorded from the humpback dolphins, Irrawaddy dolphins and spinner dolphins respectively. Echolocation clicks (hereafter clicks) were recorded from all three species. Only the humpback dolphins and Irrawaddy dolphins' burst pulses were recorded in this study. Humpback dolphins were then chosen to be further investigated as they can represent the coastal small odontocetes found in this area. The dolphins' whistle and clicks variation in relation to group behaviour, group size, formation, and environmental factors; water depth, tidal phase and the location were examined in Chapter 3. A generalized linear mixed model (GLMM) showed that the dolphins' whistle rate decreased as group size increased. A higher click train rate was also detected in foraging groups. Higher whistle rates were also found in Perlis-Kedah compared to the Langkawi archipelago. The tidal phase and water depth did not influence the species' acoustic parameters. Results suggest that the dolphins did not show vocal plasticity in frequency

parameters (i.e. whistle duration, frequency and COFM) but altered whistle rates between sites, indicating that the population may be connected. Lastly, the impacts of boat presence on the humpback dolphins' acoustic behaviour were examined in Chapter 4. A total of 78 dolphin-boat encounters were observed. The whistle and click train rates before boat presence were higher compared to after boat presence, possibly to alert on incoming danger. A higher mean inter-click interval was detected during boat presence, indicating that the dolphins were interpreting their surroundings or detecting the boats. Results suggest that there is an opportunity for expansion of the research to determine whether the impact of boat noise has a negative effect on the humpback dolphins' acoustic behaviour. In conclusion, this study provided an understanding of the dolphins' acoustic behaviour which can be used as an important baseline for future studies not only in Malaysia but throughout the Southeast Asian region. Examining the variation in acoustic behaviour due to boat presence will assist in a significant contribution to the conservation of small cetaceans.